

REMARKS

Applicants acknowledge the indication of the allowability of the subject matter of Claims 4-8, 10-18, and 22-29, as stated at paragraph 3 of the Office Action. In particular, the latter claims would be allowable if rewritten in independent form. However, for the reasons set forth hereinafter, Applicants believe that these claims are allowable in their present dependent form. Accordingly, they have not been amended at this time.

Claims 1-3, 9 and 19-21 have been rejected under 35 U.S.C. §102(e) as anticipated by Magiawala et al (U.S. Patent No. 6,278,361). However, as indicated in the analysis which follows, Applicants respectfully submit that the rejected claims distinguish over the Magiawala et al reference. New Claims 30-32 have been added, which also distinguish over Magiawala et al for the same reasons.

The present invention is directed to a method and apparatus for detecting damage to the shock absorber of a vehicle. It is based on the inventors' determination that a conclusion can be drawn with respect to shock absorber condition, by analyzing the rotational wheel speed signals generated by the speed sensor unit in an existing antilock braking system (ABS), in certain frequency ranges. More specifically, the signals output by the existing speed sensor of an ABS system can be used to generate time varying signals representing either (or both) the rotational speed change Δn of the wheel rim or

the radius change Δr of the tire. From these time varying signals (for either Δn or Δr), an auto power density spectrum ($\Phi_{\Delta r}$ or $\Phi_{\Delta n}$) can be computed, as discussed in the specification at page 3.

Within the scope of the invention, the inventors have also determined that in the auto power density spectrum for both Δr and Δn , there are frequency ranges ("analysis frequency ranges") in which the spectral values depend on the performance of the shock absorber, and other frequency ranges ("reference frequency ranges") within which the values are essentially independent of shock absorber performance. Accordingly, it is possible to generate a "characteristic shock absorber damage value", which changes when shock absorber performance deteriorates, by comparing (in particular, forming the quotient of) the spectral values within these two frequency ranges.

The Magiawala et al reference is similar to the present invention in that it provides a method and apparatus for monitoring shock absorber performance, based on a spectral analysis of certain signal values. However, the Magiawala et al reference differs from the present invention in a number of fundamental respects. Most significantly, the basic input signals which are utilized by Magiawala et al for this purpose are "radial acceleration" signals generated by a radial accelerometer 2. (See Column 1, lines 58-60; Column 2, lines 31-33; and Column 6, lines 35-37.) As indicated at Column 3, lines 50-53, "by radial acceleration is meant the acceleration of the wheel or tire in a radial direction, i.e., in a direction perpendicular to the axis of rotation of the tire." (*emphasis added*) It is thus apparent, that the basic signal data which are processed in

Magiawala et al in order to evaluate the condition of the shock absorber (being related to, for example, up and down "bouncing" of the wheel) are altogether different from that of the present invention, in which rotational wheel speed signals of an antilock braking system rotational wheel speed sensor are analyzed. That is, rotational wheel speed on the one hand and radial acceleration of a vehicle wheel on the other hand are very different quantities.

In view of this difference, it is not surprising that the analysis used in Magiawala et al in order to determine shock absorber performance is also very different from that of the present invention. In particular, as described in the specification at Column 2, lines 28-52, and also a Column 6, lines 33-58, the wheel radial acceleration signals generated by the radial accelerometer 2 are transformed to the frequency domain by use of a Discrete Fourier Transform (DFT) of the acceleration signals. The amplitude of the Fourier component of the radial acceleration in the range of 0.5 - 2.0 Hz is then compared with previously determined stored amplitude profile information in the same frequency range. Any change in the amplitude profile within the 0.5 - 2.0 Hz frequency range, compared with the stored values for the same frequency range is indicative of shock absorber wear.

Based on the above brief description, it follows that independent Claims 1 and 19 distinguish over Magiawala et al. That is, Claim 1, for example, recites a step of "detecting wheel speed signals of an antilock braking system rotational wheel speed sensor". As noted previously, the Magiawala et al reference does use or detect such wheel speed signals from an ABS system, and does not use

them to determine shock absorber condition. Indeed, one of the advantages claimed by the Magiawala et al reference is that, quite contrary to using signals from ABS wheel speed sensors, the system disclosed there can be used to replace such wheel speed sensors, as indicated at Column 7, lines 24-25. Accordingly, no wheel speed sensors are utilized in Magiawala et al, and the signals that are used and processed according to Magiawala et al are not comparable to rotational wheel speed signals.

Independent Claim 19 is an apparatus claim that is limited similarly to method Claim 1. In particular, Claim 19 recites a processing unit coupled to receive wheel speed signals from rotational wheel speed sensors, with the processing unit determining characteristics of the shock absorber by analyzing the wheel speed signals of the antilock brake system. These features are also neither taught nor suggested by Magiawala et al.

Paragraph 2 of the Office Action states that Magiawala et al discloses a method for detecting shock absorber damage which includes "detecting wheel speed signals of an antilock braking system rotational wheel speed sensor", referring in particular to Column 7, lines 16-30. However, having carefully reviewed this portion of the specification in Magiawala et al, Applicants could find no such disclosure. As noted previously, Magiawala et al neither contains nor utilizes rotational wheel speed sensors from an antilock braking system, and the signals which are processed according to Magiawala et al are not rotational wheel speed signals. Indeed, as noted previously, Magiawala et al specifically

points out that the system disclosed there can be used "to replace the wheel speed sensors currently being used."

Claim 2 further distinguishes over Magiawala et al, reciting that the analysis of the wheel speed signals includes the determination of a temporal course of either i) a radius change Δr of a vehicle tire, or ii) a rotational speed change Δn of a wheel rim. Magiawala et al discloses neither of these techniques. In particular it contains no discussion of analyzing either wheel speed change Δn or radius change Δr of the vehicle tire. In this regard, the Office Action refers to Column 7, lines 46+; however, once again Applicants found no discussion of any relationship between tire radius and tire pressure, and indeed no discussion of tire radius at all. Rather, that portion of the specification states only that "at a given nominal tire pressure", the fast Fourier Transform of the tire pressure signal is determined, and can be used as a base line number for comparison in order to detect temporal changes. In particular, the statement at Column 7, lines 55-57 that, "for example, a radial signal amplitude increase in a range of 0.5 to 2 Hz is indicative of a non-functional shock absorber", is clearly a reference to an increase in the "radial acceleration signal", as discussed more specifically at Column 5, lines 38-41 and Column 6, lines 43-54. Neither this portion of the disclosure nor any other portions appears to contain any discussion or analysis of tire radius change Δr , as recited in Claim 2.

For the same reasons discussed in the preceding paragraph, it is also apparent that Magiawala et al contains no disclosure of the computation of an

auto power density spectrum for the temporal course of radius change Δr or rotational wheel speed Δn , as recited in Claim 3.

Claims 20 and 21 are similar to Claims 2 and 3, respectively, and accordingly are allowable for the same reasons.

In light of the foregoing remarks, this application should be in condition for allowance, and early passage of this case to issue is respectfully requested. If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #951/49617).

Respectfully submitted,



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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Please amend the claims as follows:

19. (Amended) Apparatus for detecting shock absorber damage[,] in a vehicle having an antilock brake system that includes a rotational wheel speed sensor, said apparatus comprising:

a processing unit coupled to receive rotational wheel speed signals from said rotational wheel speed sensor;

wherein said processing unit determines [for determining] characteristics of a shock absorber by analyzing said rotational wheel speed signals of [an] said antilock brake system rotational wheel speed sensor.